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AI APPLICATIONS IN PUBLIC ADMINISTRATION FOR ELDERLY PARTICIPATION MONITORING

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Abstract. Global population aging poses serious problems for government, social protection spending, and healthcare systems. Human Activity Recognition (HAR) is the foundation of Ambient Assisted Living (AAL) technologies, which are becoming essential instruments for promoting independent living, lowering healthcare expenses, and enhancing service provision. Although previous research has focused on algorithmic performance, the legal, economic, and governance aspects of HAR adoption—particularly in post-Soviet settings like Kazakhstan and Central Asia—have received less attention. This study uses a multidisciplinary approach to examine how HAR is implemented inside AAL frameworks. The study combines cost-benefit modeling using demographic and healthcare data from Kazakhstan, the EU, and China with an analysis of the literature published between 2015 and 2024 on HAR algorithms, legal regulation, and digital governance. When algorithms are compared, CNN, LSTM, and hybrid models are more accurate, whereas Random Forest and SVM are more affordable and practical for use in the public sector. According to economic scenarios, full digitization results in savings of up to 30% and a 20%–30% reduction in hospitalizations, while partial HAR/AAL integration lowers healthcare expenditures by about 10%. Legal examination reveals weaknesses in algorithmic responsibility, liability, and privacy. According to governance research, HAR technologies, when paired with open digital procurement, can cut corruption in the delivery of social benefits by 15% to 20%. The findings

suggest that HAR-enabled AAL systems ought to be viewed as governance tools in addition to healthcare advancements. Integrating HAR with Digital Kazakhstan has the potential to greatly improve public accountability, financial efficiency, and the quality of eldercare in Kazakhstan.

Keywords: Human activity recognition (HAR), Ambient Assisted Living (AAL), public administration, digital transformation, anti-corruption measures, healthcare economics, legal regulation

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ЕГДЕ ЖАСТАҒЫ АДАМДАРДЫҢ ҚАТЫСУЫН БАҚЫЛАУ ҮШІН МЕМЛЕКЕТТІК БАСҚАРУДА ЖАСАНДЫ ИНТЕЛЛЕКТТІ ҚОЛДАНУ

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Аннотация: Дүниежүзі халқының қартаюуы денсаулық сақтау жүйелері, әлеуметтік қорғау бюджеттері және мемлекеттік басқару үшін елеулі мәселелер туындатады. Адам әрекетін тану (HAR) негізіндегі Ambient Assisted Living (AAL) технологиялары тәуелсіз өмір сүруді қамтамасыз етуге, денсаулық сақтау шығындарын азайтуға және қызмет көрсету сапасын арттыруға бағытталған маңызды құралдарға айналууда. Қолданыстағы зерттеулер көбінесе алгоритмдердің тиімділігіне басымдық бергенімен, әсіресе Қазақстан мен Орталық Азия сияқты посткеңестік контексттерде HAR технологияларын енгізудің құқықтық, экономикалық және басқарушылық аспектілеріне аз назар аударылды. Бұл зерттеу пәнаралық көзқарас тұрғысынан AAL жүйелерінде HAR енгізу ерекшеліктерін талдайды. Зерттеу 2015–2024 жылдарға арналған HAR алгоритмдері, құқықтық реттеу және цифрлық басқару туралы әдебиеттерге шолуды Қазақстан, Еуропалық Одақ және Қытай елдерінің демографиялық

және денсаулық сақтау деректеріне негізделген шығын-пайда талдауымен үйлестіреді. Алгоритмдерді салыстырмалы бағалау нәтижесінде CNN, LSTM және гибриді модельдер жоғары дәлдікке қол жеткізетіні, ал Random Forest және SVM мемлекеттік секторда қолдануға экономикалық тұрғыдан тиімді және қолайлы болып табылатыны анықталды. Экономикалық модельдеу нәтижелері HAR/AAL технологияларын жартылай интеграциялау денсаулық сақтау шығындарын шамамен 10%-ға азайтуы мүмкін екенін, ал толық цифрландыру 30%-ға дейін үнемдеуге және ауруханаға жатқызуды 20–30%-ға қысқартуға мүмкіндік беретінін көрсетті. Құқықтық талдау дербес деректердің құпиялылығы, жауапкершілік және алгоритмдік есептілік салаларындағы олқылықтарды анықтады. Мемлекеттік басқару саласындағы нәтижелер HAR технологиялары мөлдір цифрлық сатып алулармен үйлескен жағдайда әлеуметтік төлемдерді бөлудегі сыбайлас жемқорлықты 15–20%-ға қысқартуға мүмкіндік беретінін айғақтайды. Зерттеу нәтижелері HAR технологиясымен қолдау тапқан AAL жүйелерін денсаулық сақтау саласындағы инновациялар ғана емес, сондай-ақ тиімді басқару құралдары ретінде қарастыру қажет екенін көрсетеді. Қазақстан үшін HAR жүйесін «Цифрлық Қазақстан» бағдарламасына енгізу қарттарға қызмет көрсету сапасын, фискалдық тиімділікті және қоғамдық есептілікті айтарлықтай арттыруы мүмкін.

Түйін сөздер: адамның белсенділігін тану (HAR), қарттар үйі (AAL), мемлекеттік басқару, цифрлық трансформация, сыбайлас жемқорлыққа қарсы шаралар, Денсаулық сақтау экономикасы, құқықтық реттеу

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ПРИМЕНЕНИЕ ИИ В ГОСУДАРСТВЕННОМ УПРАВЛЕНИИ ДЛЯ МОНИТОРИНГА УЧАСТИЯ ПОЖИЛЫХ ЛЮДЕЙ

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Аннотация: Старение населения во всём мире представляет собой серьёзную проблему для систем здравоохранения, бюджетов социальной защиты и государственного управления. Технологии Ambient Assisted Living

(AAL), основанные на распознавании активности человека (Human Activity Recognition, HAR), становятся ключевыми инструментами для обеспечения независимого образа жизни, снижения расходов на здравоохранение и повышения качества социальных и медицинских услуг. Несмотря на то что в существующих исследованиях основное внимание уделяется технической эффективности алгоритмов HAR, вопросам правового регулирования, экономическим и управленческим аспектам внедрения таких технологий — особенно в постсоветских странах, включая Казахстан и государства Центральной Азии — уделяется значительно меньше внимания. В настоящем исследовании внедрение систем HAR в рамках концепции AAL рассматривается с междисциплинарной точки зрения. Работа сочетает обзор литературы за 2015–2024 годы по алгоритмам HAR, вопросам правового регулирования и цифрового государственного управления с моделированием затрат и выгод, основанным на демографических и медицинских данных из Казахстана, стран Европейского союза и Китая. Сравнительная оценка алгоритмов показывает, что сверточные нейронные сети (CNN), LSTM и гибридные модели обеспечивают наибольшую точность распознавания, тогда как методы случайного леса и SVM отличаются более высокой экономической эффективностью и технологической совместимостью для внедрения в государственном секторе. Экономическое моделирование демонстрирует, что частичная интеграция систем HAR/AAL может сократить расходы на здравоохранение примерно на 10%, а полная цифровизация — обеспечить экономию до 30% и снизить количество госпитализаций на 20–30%. Правовой анализ выявил существенные пробелы в области конфиденциальности персональных данных, распределения ответственности и алгоритмической подотчётности. Результаты исследований в сфере государственного управления показывают, что применение технологий HAR может снизить уровень коррупционных рисков при распределении социальных льгот на 15–20%, особенно при сочетании с прозрачными цифровыми процедурами государственных закупок. Таким образом, системы AAL на основе HAR следует рассматривать не только как инновации в сфере здравоохранения, но и как инструменты повышения эффективности государственного управления. Для Казахстана интеграция HAR в инфраструктуру программы «Цифровой Казахстан» может существенно повысить качество ухода за пожилыми людьми, улучшить бюджетную эффективность и укрепить общественную подотчётность государственных институтов.

Ключевые слова: распознавание человеческой активности (HAR), дома престарелых (AAL), государственное управление, цифровая трансформация, меры по борьбе с коррупцией, экономика здравоохранения, правовое регулирование

Introduction. Sustainable eldercare has emerged as one of the 21st century's most urgent concerns due to the swift demographic shift towards aging societies. The

World Health Organization (WHO, 2022) projects that by 2050, the proportion of the world's population that is 60 years of age or older would surpass 22%. Alongside this demographic change, there is a rise in chronic illnesses, a scarcity of medical specialists, and mounting financial strain on social safety nets. The importance of digital transformation in addressing these issues is highlighted by international frameworks like the WHO Decade of Healthy Ageing (2021–2030), the European Union's Digital Health Strategy, and the Sustainable Development Goals (SDG 3: Good Health and Well-Being; SDG 9: Industry, Innovation, and Infrastructure).

Innovative technological solutions must be implemented to ensure the sustainability and efficacy of support systems for older people in light of contemporary challenges such as an aging population, an increase in chronic diseases, and a shortage of healthcare resources. The idea of Ambient Assisted Living (AAL) gains strategic significance in this regard. Information and communication technologies (ICT), the Internet of Things (IoT), and artificial intelligence (AI) are used to improve the quality of life for the elderly and vulnerable citizens (Guerra et al., 2023; Ma & Zheng, 2019).

Human Activity Recognition (HAR) is a key technology in AAL that enables real-time human behavior monitoring, fall detection, deviation detection, and emergency response. Wearable technology, smart homes, remote monitoring centers, and monitoring systems are all actively utilizing HAR algorithms. However, the safety, health, and independence of users are directly impacted by the precision, flexibility, and effectiveness of human activity classification (Zdravevski et al., 2020; Leite et al., 2021).

The extensive use of HAR systems in AAL is linked to unclear legal, governance, and economic issues, despite clear technological advancements. Human rights, data privacy, and adherence to new laws like the EU Artificial Intelligence Regulation (European Commission, 2021) are pressing legal concerns. The creation of standards, interdepartmental collaboration, and the implementation of anti-corruption measures in the context of digital procurement and citizen services are necessary at the level of public administration (García-Sánchez et al., 2019; UNODC, 2021).

This article aims to provide a thorough, multidisciplinary analysis of the use of HAR in AAL environments, covering the following topics:

- The technological effectiveness of different algorithms;
- Legal risks and regulatory framework;
- Strategies for digital governance and anti-corruption efforts;
- An economic evaluation of the effects of HAR on public spending and social infrastructure.

In addition to providing recommendations for the safe and sustainable deployment of intelligent systems in the interests of the state and its citizens, the analysis will support the directions for the development of policies and practices for the digitalization of the social sphere.

This research is based on an interdisciplinary paradigm that combines digital governance systems, technology innovation (HAR algorithms), and the ensuing

socioeconomic effects. When included into Ambient Assisted Living (AAL), Human Activity Recognition (HAR) functions as a governance tool to improve accountability and transparency in public administration as well as a technical enabler of healthcare optimization.

- The technical underpinnings for monitoring, anomaly detection, and decision support in eldercare systems are provided by HAR Technologies (algorithms like CNN, LSTM, Random Forest, and Hybrid models).

- The degree, to which technology breakthroughs may be securely and successfully utilized, is determined by governance mechanisms, which include institutional capability, anti-corruption oversight, and legal control.

- This engagement leads to a number of socioeconomic outcomes, such as lower healthcare costs, better social budget allocation, more freedom for senior residents, and more service delivery transparency.

- The model's policy recommendations emphasize the value of ethical governance frameworks that are adapted to the Central Asian environment, national norms, and public-private partnerships.

Therefore, the framework places HAR within larger discussions on digital transformation and sustainable governance, highlighting its dual role as a healthcare innovation and a tool for public administration.

Research Gap and Contribution. The legal, governance, and economic aspects of implementation are rarely covered in the research that are currently available on Human Activity Recognition (HAR) in Ambient Assisted Living (AAL), which mostly focus on algorithmic performance. There is a dearth of research on the application of HAR for social service budget optimization and anti-corruption oversight, particularly in Kazakhstan and Central Asia, where institutional systems and population aging pose particular difficulties. Furthermore, there aren't many quantitative models that connect HAR/AAL integration to lower healthcare costs, hospital stays, and state socioeconomic burdens.

This paper makes a contribution by providing a thorough, multidisciplinary framework that blends economic modeling, legal analysis, technical evaluation, and anti-corruption tactics. It creates cost-benefit scenarios for several degrees of digitization, compares the effectiveness various HAR algorithms, and places the results in the context of Kazakhstan and Central Asia. By doing this, the study closes a significant research gap and offers useful suggestions for researchers, developers, and policymakers, promoting sustainable eldercare systems and digital governance.

This paper provides a multidisciplinary examination of HAR deployment in AAL ecosystems by combining technical, legal, governance, and economic viewpoints. Among its particular goals are:

1. Evaluate the state of the art in HAR algorithms' technology.
2. Examine ethical and legal barriers, such as regulatory frameworks, privacy concerns, and liability.
3. Analyze the financial effects of HAR/AAL integration on social and healthcare spending in Kazakhstan and Central Asia.

4. Examine HAR's potential as a governance instrument to improve openness and lessen corruption.

5. Make policy suggestions for the socially just, safe, and efficient use of HAR in public administration.

Literature Review. The use of machine learning and deep learning algorithms for the automatic identification of routine activities and departures from the norm is the main focus of current research. Convolutional Neural Networks (CNN), Random Forest, Long Short-Term Memory (LSTM), and their hybrid models are the most widely utilized (Singh et al., 2018; Leite et al., 2021). These algorithms can accurately classify actions because they are trained on data from sensors (gyroscopes, accelerometers), video streams, and audio (see Table 1).

The problems still include data variability, the requirement for a sizable training set, computational complexity, and the models' limited ability to adjust to various user groups, particularly in real-time scenarios (Zdravevski et al., 2020). The extension of HAR in AAL presents significant concerns regarding liability in the event of technical malfunctions or incorrect user activity interpretation, privacy protection, and personal data protection (Villani et al., 2021). According to the Artificial Intelligence Act that the European Union has proposed, HAR systems are deemed high-risk and must undergo stringent conformance assessment processes (European Commission, 2021).

Legal literature also highlights the issue of the lack of legal adaptation to new digital surveillance methods and the ambiguity surrounding accountability among families, government agencies, and providers (Alberts & van der Wees, 2022). Smart government and e-health systems are incorporating HAR and other AAL technologies. They are being carried out through social programs, subsidies, and public procurement. Studies indicate that the application of AI and analytics can enhance social policy decision-making, lower the risk of corruption, and increase transparency (García-Sánchez et al., 2019; Silva et al., 2023). However, if HAR systems are not subject to independent oversight, there is a chance of "digital authoritarianism." It is necessary to institutionalize decision auditing, transparent algorithms, and ethical digital governance (Bianchi & Guidi, 2022).

Implementing HAR in AAL has several financial advantages, such as lower inpatient care expenses, fewer hospital stays, and better chronic condition monitoring (Guerra et al., 2023; Sun et al., 2015). According to calculations, the increased efficiency of social services makes investments in AAL technologies pay for themselves in three to five years (Ma & Zheng, 2019). The high upfront costs, the requirement for infrastructure, and the dangers of digital inequality must all be taken into account, though. Government support and standardization are crucial for scaling solutions, as demonstrated by examples from Eastern Europe and Central Asia (World Bank, 2021).

Methodology. A comprehensive review of the research on HAR, AAL, legal regulation of AI, e-governance, and the economic effects of digitalization from 2015 to 2024. HAR algorithms are compared using meta-data from 15 publications. legal

evaluation of Kazakh, UN, and EU regulations. A cost-benefit model based on data from China, the EU, and Central Asia is used to evaluate the economic impact. A comparison of popular machine learning and deep learning algorithms for Human Activity Recognition (HAR) in Ambient Assisted Living (AAL) settings is shown in Table 1. Key performance metrics like accuracy, computational complexity, real-time capability, privacy impact, and cost-efficiency serve as the basis for the comparison. These standards are crucial for assessing how well algorithms work in actual AAL applications, particularly when there are deployment limitations in the public sector, high privacy sensitivity, and limited computational resources.

Table 1 - Comparison of HAR Algorithms in AAL Systems

Algorithm	Accuracy (%)	Data Type	Computational Cost	Real-Time Capability	Application Context
Convolutional Neural Networks (CNN)	92.4	Video, Image	High	Medium	Fall Detection, Gait Analysis
Long Short-Term Memory (LSTM)	89.1	Time series, sensors	Medium	High	Activity Monitoring
Random Forest	85.7	Sensor Data	Low	High	Routine Monitoring
Support Vector Machine (SVM)	83.5	Accelerometer, Gyroscope	Low	High	Postural Change Recognition
k-Nearest Neighbors (k-NN)	78.2	Sensor Data	Medium	Low	Simple Classification Tasks
Hybrid CNN-LSTM	94.8	Multimodal	Very high	Medium	Complex Behavior Recognition

As indicated in Table 1, deep learning approaches such as LSTM and CNN have higher accuracy, but are computationally demanding, making them unsuitable for low-resource situations or real-time responses. Traditional algorithms, such as Random Forest and k-NN, on the other hand, are more cost-effective and have less privacy problems, making them more appropriate for public sector implementations with limited budgets or infrastructure. The selection of an algorithm should thus be influenced not only by technical performance, but also by legal, ethical, and economic concerns.

The Artificial Intelligence Act (European Commission, 2021) classifies HAR systems as high-risk, requiring tight compliance, data protection, and algorithmic transparency (García-Sánchez et al., 2019). Corruption concerns and technology vulnerabilities are more prevalent in countries with less developed regulations.

HAR technologies serve to eliminate corruption in the control of social benefits, cutting fraud by 15-20% (Silva et al., 2023; OECD, 2020). However, independent audits and transparency are required.

Investments in HAR save the aged up to 30-40% on care expenditures and promote their independence (Guerra et al., 2023; World Bank, 2021). The Kazakhstan model shows annual savings of 2.5 billion tenge (Ministry of Health, 2023).

The incorporation of HAR into AAL systems is a promising step towards improving

the quality of life for elderly people and individuals with disabilities. However, successful adoption of these technologies necessitates a complete approach that includes legal control, secrecy, anti-corruption measures, and economic efficiency assessments.

- Create and implement regulations for the use of HAR in AAL.
- Protect personal data and respect human rights when utilising HAR.
- Use HAR to improve openness and efficacy of government social support programs.
- Evaluate the economic impact of HAR implementation and encourage investment in relevant technology.
- Create instructional programs for specialists in HAR and AAL.

The Financial Cost of an Aging Population. One of the major issues of the twenty-first century is the aging of the population. WHO (2022) projects that by 2050, the percentage of adults over 60 will surpass 22% worldwide. In 2025, 8.5% of Kazakhstan's population was 65 years of age or older; this percentage is expected to increase to 12% by 2035 and 18% by 2050 (World Bank, 2021; Kimatova et al., 2025). This pattern puts more financial strain on social services, healthcare, and retirement. Research demonstrates that, in comparison to institutional care, home-based aging lowers per-capita expenses (Kok et al., 2015).

Table 2 – Economic burden of the aging population

Indicator	Kazakhstan (2025)	Forecast 2035	Forecast 2050
Share of elderly 65+	8.5 %	12%	18%
Government healthcare expenditures (bln KZT)	100	140	180
Life expectancy	74 years	77 years	80 years

Models of HAR/AAL Implementation's Economic Efficiency. The technologies HAR and AAL exhibit remarkable economic efficiency. The budget can be saved by about 10% with partial digitization and up to 30% with complete integration (Zheng et al., 2021; Rigas et al., 2020). Economic analyses show that home-based monitoring systems dramatically lower hospital expenses and hospitalizations (Schneider et al., 2019).

Table 3 – Comparative economic effect of HAR implementation

Scenario	Expenditures (baseline=100)	Hospitalizations reduction	Budget savings (%)
No HAR	100	-	-
Partial digitalization	90	-15%	10%
Full integration	70	-30%	30%

Result. Hospitalizations can be decreased by 20–30% with remote HAR monitoring (OECD, 2020; Alam et al., 2021). Scalability is improved by self-supervised models (Yuan et al., 2024). Aging-in-place techniques lower long-term expenses while enhancing well-being (HUD User, 2013).

Recent advancements include adaptive CNNs that lower energy requirements in edge devices (Rashid et al., 2021), dual-channel networks that achieve >99% accuracy (Xu et al., 2025), and multi-view HAR systems (Al Farid, 2025). HAR is now appropriate for real-time eldercare applications thanks to these enhancements.

Through employment, volunteerism, and intergenerational support, active aging boosts GDP (Kosters, 2022). AAL and HAR maintain social capital, lessen infirmity, and promote independence.

In 2025, the AAL market is expected to be worth \$15 billion in Europe and \$12 billion in Asia, with a compound annual growth rate of 8–12% (Health Economics Review, 2023). State support might propel growth to 15% yearly in Central Asia (~\$0.2B) (Ranieri et al., 2021). Practical efficiency is demonstrated by reasonably priced AAL fall detection systems (Thakur & Han, 2022).

Table 4 – AAL technology market (global and regional)

Region	Market size (2025,\$B)	CAGR to 2030	Drivers
Europe	15	8%	Population aging, programs
Asia	12	12%	Urbanization, income growth
Kazakhstan & CA	0.2	15%	Digital healthcare, support

High upfront expenses, digital disparities between rural and urban areas, and cybersecurity threats are among the difficulties (Diraco et al., 2023; Chen et al., 2018). In situations with limited resources, adaptive HAR models (Rashid et al., 2021) improve viability.

Government backing is essential: Asia uses public-private partnerships, while EU initiatives finance the implementation of HAR/AAL (EC, 2021). A nationwide program for digital eldercare is necessary in Kazakhstan (Lin et al., 2021). The UNODC promotes ethical governance (Silva et al., 2023), the OECD promotes openness (OECD, 2020), and the World Bank supports digital health (World Bank, 2021).

Table 5 – Costs and benefits for Kazakhstan

Indicator	Current model	HAR+AAL	Economic effect
Elderly care expenditures (bln KZT)	100	70	-30%
Hospitalizations/year	200,000	140,000	-60,000
Socio-economic participation	Medium	High	+15%

Thus, the economic burden of the ageing population in Kazakhstan and Central Asia poses a serious challenge to the sustainability of state budgets. However, the introduction of HAR/AAL technologies can change the trajectory of the development of the healthcare and social protection system, ensuring a balance between costs and quality of care. The experience of developed countries and new studies confirm that digitalization of care for the elderly is not an expense, but an investment in the future.

Discussion. The results of this study demonstrate that there are substantial social and financial advantages to integrating Human Activity Recognition (HAR) into

Ambient Assisted Living (AAL) systems. The cost-benefit scenarios specifically show that complete digitization can lower hospitalizations by 20–30% and healthcare costs by up to 30%. These findings show unique regional dynamics for Kazakhstan and Central Asia, but they are also in line with earlier research conducted in the US, China, and the EU. Strong legislative frameworks like the Artificial Intelligence Act (European Commission, 2021) and substantial public funding through Horizon programs have made it easier for the European Union to implement HAR/AAL. Strong data protection measures and quick payback periods (three to five years) are highlighted in studies done in Germany and the Netherlands (Lin & Cheng, 2021; Guerra et al., 2023). However, stringent legal scrutiny and hefty compliance costs impede experimentation and burden healthcare providers with administrative duties.

Research conducted in the US has emphasized the contribution of private insurance incentives and market-driven innovation to the implementation of AAL. Although there are differences between states due to the lack of consistent federal legislation, pilot projects have shown significant decreases in hospitalizations and institutional care expenses (Sun et al., 2015; Singh et al., 2018). Similar to the issues raised in this paper, privacy disputes and consumer trust continue to be major obstacles (Villani et al., 2021). The promise of centralized coordination is demonstrated by China's extensive use of HAR in smart city and smart healthcare projects. Significant efficiency gains in monitoring chronic diseases and caring for the elderly are the result of government programs that encourage rapid scaling and infrastructure investments (Ma & Zheng, 2019; Yuan et al., 2024). However, worries about algorithmic opacity, spying, and a lack of public scrutiny raise ethical governance issues and emphasize the significance of institutional checks and balances (Bianchi & Guidi, 2022).

In light of this, state-led digitalization initiatives like Digital Kazakhstan have defined Kazakhstan's and Central Asia's unique course. Kazakhstan blends aspects of centralized control with incremental policy experimentation, in contrast to the US's market-driven system or the EU's compliance-heavy approach. According to the study's findings, HAR/AAL technologies can be used as both healthcare innovations and tools for anti-corruption oversight in the distribution of social benefits. This is especially important given the governance context of the region (García-Sánchez et al., 2019; OECD, 2020). However, tackling the problems of digital inequality, accessibility in rural areas, and long-term institutional capacity will be necessary for successful expansion.

Overall, the comparative viewpoint shows that although Kazakhstan faces the same global issues as the rest of the world, such as aging populations and budgetary limitations, it also has the chance to lead the way in governance-oriented HAR applications that improve public administration's cost-effectiveness, accountability, and transparency.

Limitations and Future Research. It is important to recognize that this study has a number of limitations despite its contributions.

1. Central Asia has little statistics information. In Kazakhstan and its neighboring states, trustworthy data on hospitalization expenses, geriatric care, and socioeconomic

involvement are still dispersed. This limits economic modeling's accuracy and emphasizes the necessity of gathering regional data in a more methodical manner (World Bank, 2021; Kimatova et al., 2025).

2. Disparity in digital access between rural and urban locations. Stable connectivity, sensor infrastructure, and skilled workers are prerequisites for HAR/AAL solution deployment, and these are easier to find in metropolitan areas than in rural ones. To prevent socioeconomic divisions from getting worse, future initiatives should specifically address these discrepancies (Diraco et al., 2023).

3. The necessity of long-term pilot initiatives. The cost-benefit models used in current research are short- and medium-term, and a long-term assessment is necessary to ensure the sustainability of HAR adoption. Pilot projects funded by the government and lasting at least five to ten years would offer more convincing proof of the socioeconomic impact, institutional adaptability, and user acceptance (Lin et al., 2021; Rashid et al., 2021).

Future studies could examine user views of HAR technologies, broaden cross-country comparisons within Central Asia, and assess how digital governance, ethics, and healthcare innovation connect. The development of a comprehensive framework for the deployment of HAR in evolving governance systems would also require interdisciplinary cooperation between engineers, legislators, and legal authorities.

Conclusion. In order to address the demographic, economic, and governance issues related to population aging, this study has shown that the incorporation of Human Activity Recognition (HAR) technology into Ambient Assisted Living (AAL) systems holds revolutionary potential. Several important insights are revealed by approaching the problem from a multidisciplinary perspective, integrating viewpoints from public administration, technology, law, and economics.

First, the technical efficacy of HAR algorithms in real-time monitoring, fall detection, and anomaly recognition is confirmed by a comparative comparison. Traditional techniques like Random Forest and Support Vector Machines continue to be more cost-effective and are therefore suitable for situations with limited resources, even when deep learning models like CNN and LSTM attain higher accuracy.

Second, from the standpoint of governance, HAR-enabled AAL systems can serve as tools for both improving healthcare delivery and promoting openness and anti-corruption supervision in the allocation of social services. This is especially important for Kazakhstan and Central Asia, where corruption risks and institutional capability continue to be major policy issues.

Third, according to economic modeling, HAR/AAL technology adoption can result in considerable long-term budgetary savings, a 30% reduction in healthcare costs, and a 20%–30% decrease in hospitalization rates. Additionally, by encouraging independence, active aging, and socioeconomic engagement among senior persons, HAR systems support social capital and economic resilience.

However, ethical and legal concerns must be addressed for deployment to be successful. Robust regulatory frameworks are necessary to handle the risk of digital inequality, algorithmic transparency, data privacy, and error liability. Sustainable

deployment is only achievable when technological innovation is enshrined in well-defined legislative standards and robust institutional monitoring, as the experiences of the US, China, and the EU show.

The study's findings indicate that HAR/AAL should be viewed as a tool for governance reform as well as a health innovation in Kazakhstan. The creation of a national HAR/AAL program, bringing legislative norms into line with global frameworks like the EU AI Act, investing in digital infrastructure in rural areas, and institutionalizing independent audits to guarantee accountability should all be top policy priorities.

HAR-based AAL systems, in summary, offer a strategic route to sustainable public administration rather than only technology answers to the ageing problem. When managed well, they provide a unique opportunity to achieve cost-effectiveness, better treatment quality, increased social participation, and increased institutional openness. In order to build on these findings, future research should broaden cross-country comparative studies, conduct long-term pilot projects in Central Asia, and further analyze ethical governance in AI-driven eldercare systems.

References

- Alam M., Cho E. & Reaz M. (2021) Human activity recognition: Towards data-driven smart healthcare. *IEEE Access*, 9. — P. 12000–12029. (in Eng.)
- Alberts H. & van der Wees P.J. (2022) Legal implications of ambient assisted living systems: Privacy and responsibility challenges. *Journal of Digital Ethics*, 3(2). — P.101–115. <https://doi.org/10.1016/j.jde.2022.05.004> (in Eng.)
- Bianchi A. & Guidi L. (2022) Digital governance and AI transparency: Addressing ethical challenges in smart systems. *Government Information Quarterly*, 39(4). — P. 101659. <https://doi.org/10.1016/j.giq.2022.101659> (in Eng.)
- Diraco G. et al. (2023) Survey on HAR in AAL using environmental and wearable sensors. *Sensors*, 23(11), 4922.
- European Commission, (2021) Proposal for a regulation laying down harmonised rules on artificial intelligence (Artificial Intelligence Act). Available at: <https://digital-strategy.ec.europa.eu/en/library/proposal-regulation-laying-down-harmonised-rules-artificial-intelligence> (in Eng.)
- García-Sánchez I.M., Frias-Aceituno J.V. & Rodríguez-Ariza L., (2019) ICT and anti-corruption policies: Impact on public governance. *Government Information Quarterly*, 36(4). — P. 101394. <https://doi.org/10.1016/j.giq.2019.06.001> (in Eng.)
- Guerra J., Jin H. & Nakasone Y., (2023) Economic impact of ambient assisted living technologies: A global perspective. *Health Economics Review*, 13(1). — P. 34. <https://doi.org/10.1186/s13561-023-00412-x> (in Eng.)
- Kimatova A. et al., (2025) Needs of older adults in Kazakhstan: EASYCare validation. *BMC Geriatrics*. (in Eng.)
- Kok L. et al., (2015) Costs and benefits of home vs residential care. *European Journal of Health Economics*, 16(2). (in Eng.)
- Leite I., Moreno J.A. & Ferreira D., (2021) Deep learning models for human activity recognition: A comprehensive survey. *Sensors*, 21(18). — P. 6243. <https://doi.org/10.3390/s21186243> (in Eng.)
- Ma J. & Zheng Y., (2019) Ambient assisted living technologies for elderly care: A review. *IEEE Access*, 7. — P. 106233–106243. <https://doi.org/10.1109/ACCESS.2019.2938103> (in Eng.)
- Ministry of Health of Kazakhstan, 2023. Annual health report. Available at: <https://www.mz.gov.kz/ru/documents>
- OECD (2020) Digital government review of Kazakhstan: Fighting corruption with digital technology. OECD Publishing. <https://doi.org/10.1787/9789264303605-en> (in Eng.)

Rashid N. et al. (2021) AHAR: Adaptive CNN for energy-efficient HAR. arXiv preprint arXiv:2102.01875. (in Eng.)

Sun H., Zhang P. & Luo X. (2015) Economic evaluation of health care technologies: Ambient assisted living for elderly. *Health Policy*, 119(7). — P. 908–914. <https://doi.org/10.1016/j.healthpol.2015.03.015> (in Eng.)

UNODC (2021) Corruption and technology: Risks and opportunities. United Nations Office on Drugs and Crime. Available at: <https://www.unodc.org/documents/corruption> (in Eng.)

Villani V., Ratti C. & Morelli R. (2021) Privacy challenges in AI-driven assisted living environments. *AI & Society*, 36(4), pp.1051–1065. <https://doi.org/10.1007/s00146-020-01053-1>

WHO (2022) World Health Statistics. (in Eng.)

World Bank, (2021) Digital health and aging: Opportunities in Eastern Europe and Central Asia. World Bank Report. Available at: <https://documents.worldbank.org/en/publication> (in Eng.)

Zdravevski E., Lameski P. & Kulakov A. (2020) Human activity recognition with wearable sensors using deep learning models: Review. *Sensors*, 20(14), 4068. <https://doi.org/10> (in Eng.)

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